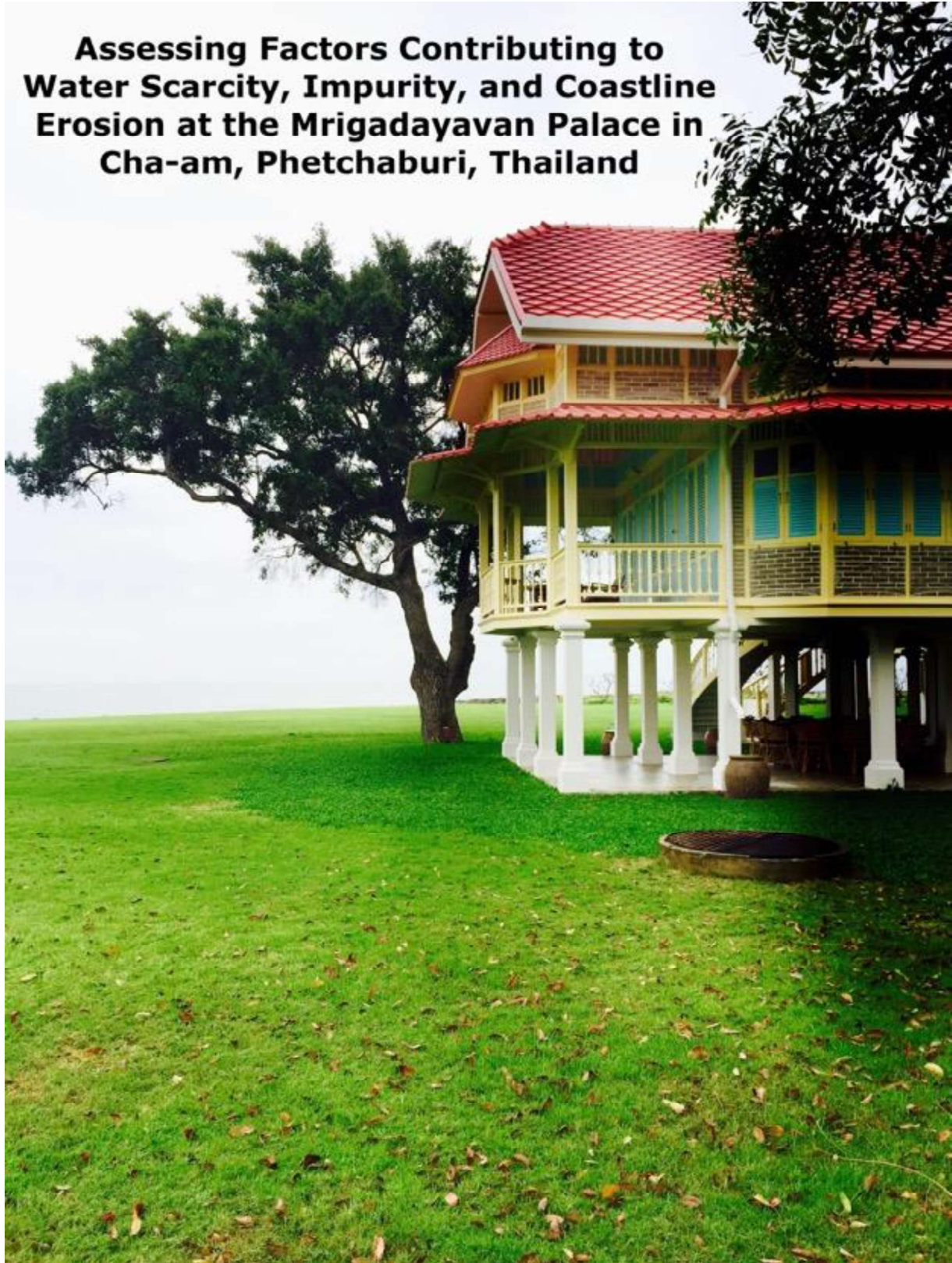
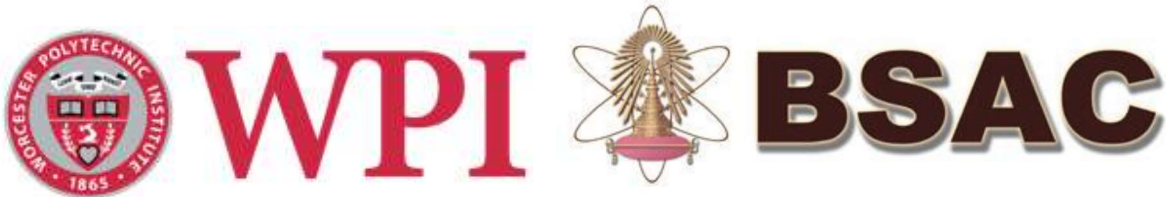


**Assessing Factors Contributing to  
Water Scarcity, Impurity, and Coastline  
Erosion at the Mrigadayavan Palace in  
Cha-am, Phetchaburi, Thailand**





# Assessing Factors Contributing to Water Scarcity, Impurity, and Coastline Erosion at the Mrigadayavan Palace in Cha-am, Phetchaburi, Thailand

**An Interactive Qualifying Project submitted to the faculties of Worcester Polytechnic Institute and Chulalongkorn University in partial fulfillment of the requirements for the Degree of Bachelor of Science in cooperation with The Foundation of the Mrigadayavan Palace.**

**Submitted on:** March 1, 2017

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**This report represents the work of four WPI and three Chulalongkorn University undergraduate students submitted to the faculty as evidence of completion of a degree requirement. WPI routinely publishes these reports on its website without editorial or peer review. For more information about the projects program at WPI, please see**

<http://www.wpi.edu/Academics/Projects>.

# Acknowledgements

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Mr. Charoen Chaisri, Chief Engineer of Novotel Hua Hin Resort and Spa  
Ms. Metha Yenjit, Resident in Sam-Phraya area of Cha-am district  
Mr. Sittipong Pratheung, Buffy's Belly Bar and Bistro Supervisor  
Mrs. Aumporn Chanpetch, Villager  
Ms. Gumrai Yodtanan, Palace Gardener  
Ms. Saman Boonsong, Resident in Sam-Phraya area of Cha-am district  
Mr. Nopporn, Springfield Golf Course

# Abstract

Freshwater sources were abundant in the Mrigadayavan Palace area until industrial and coastal developments influenced the quality of water in the Palace. The goal of our project is to maintain the Mrigadayavan Palace's legacy and tradition by investigating the factors affecting water quality and quantity. We have completed this goal by analyzing the availability of water and impurities and the factors impacting the water sources, and investigating public opinion on man-made structures. Our team produced an informational video and sign about the effects of the man-made structures. We concluded that the area's water became brackish due to the jetties allowing seawater to flow further inland through the canals to nourish the artificial mangrove forests.

# Executive Summary

## Background

King Rama VI lived in the historical Mrigadayavan Palace, located on the coastline of the Cha-am district, during the summer seasons of 1924 and 1925. After the King passed away in 1925, the Palace was in disrepair until 1965. The Mrigadayavan Palace, Border Patrol Police, and the Sirindhorn International Environmental Park now reside in the King Rama VI Military Camp. Founded in 1992, the Foundation of Mrigadayavan Palace works toward the restoration of the Palace to its original landscape and horticulture, as well as serve as an example of environmental sustainability for the Camp and district. The Foundation continuously struggles in this endeavor due to natural disasters such as monsoons and storms, as well as the construction of coastal protection structures.

To protect the shoreline and the Palace, the Marine Department helped the Foundation of Mrigadayavan Palace construct man-made coastal structures such as jetties, groynes, breakwaters, and a seawall. Groynes are located perpendicular to the shoreline and trap sand on their sides. Breakwaters are structures parallel to the shoreline and reduce the impact of large waves on the shoreline, and the seawall protects the Palace by keeping the land closest to the beach from eroding. Jetties allow seawater to flow inland to water the mangrove forests that the Sirindhorn International Environmental Park implemented within the Camp in 1994. This caused seawater to mix with freshwater sources, causing water in the canals to become brackish. Therefore, the Palace currently uses water from Ta Sa-ded reservoir, which is a freshwater reservoir located inside the Camp, for their plants.



Figure 1: Map of coastline of the Mrigadayavan Palace and the surrounding area



## Our Goal & Objectives

The goal of our project was to maintain the environmental and historical legacy of the Mrigadayavan Palace by investigating the factors affecting the water quality and quantity.

Our objectives for this project were as follows:

1. Analyze the water quality and quantity within the Palace area.
2. Collect and analyze data on the factors that impact the region's water sources.
3. Investigate the current public opinion and perception of coastal man-made structures (jetties, groynes, seawall, and breakwaters) as well as the current state of the water in their area.
4. Develop an informative video and sign about water impurity and coastline erosion to present at the Palace.

## Methodology

In order to accomplish the stated goal, we completed the four objectives by collecting data from interviews with local residents, a gardener, and specialists who work for the Palace. We used these objectives to gain knowledge about water quality and quantity in the Palace area. In order to understand the factors that impact the region's water sources, we also conducted interviews with the Palace's staff, nearby communities, and experts. In addition, we visited many locations affected by water quality and quantity problems, such as small fishing villages and the Mrigadayavan Palace. We toured the Palace to observe man-made structures, such as jetties, a seawall, groynes, and breakwaters. At the Sirindhorn International Environmental Park, we followed a guided tour through the artificial mangrove forest. The Huai Sai Royal Development Center taught us about water conservation, preservation, and water sources from the mountains that may have an impact on groundwater levels in the Rama VI Camp. The sites also allowed us to gain an understanding of local residents' perceptions of the man-made structures and the current state of water quality in the area. From data collection and analysis, we created an informational video and sign to be implemented at the Palace. They provided information on the causes of water scarcity, water salinity, and coastline erosion. The video and sign would be a first step toward helping the community understand all aspects, positive and negative, of the structures within the area so they can make informed decisions in the future.

## Results and Findings

From the data we gathered, we found that groundwater in the area is scarce, and the water that is present has become brackish and is difficult to utilize in the Palace area. We continued researching to find the causes of this problem, which we found can be mainly attributed to urbanization and the addition of the artificial mangrove forests. Urbanization has led to the overexploitation of local water sources such as underground water that supplies personal wells due to the high demand of water from the increasing population. The mangrove forests near the Palace need seawater, which is brought in through a permanent opening in the jetties. Because of this, the water in the canals has a very high salinity level. The brackish water permeates the soil, affecting the soil to become salty. Our team learned that the very jetties that bring the seawater into the Palace grounds are a feature of a set of man-made coastal structures that the Marine Department

introduced eleven years ago to protect the coastline. In actuality, the jetties, along with a network of groynes, breakwaters, and a seawall, are causing changes to the coastline.

Most local residents found the jetties and offshore breakwaters more beneficial than detrimental. Most fishermen found the offshore breakwaters beneficial to them in order to anchor their boats and prevent damage from harsh waves and storms. The majority of the local residents we interviewed stated that the negative effects of the structures impacted them very minimally, while the benefits have influenced them greatly. Farmers living inland, far from the sea shoreline, do not find the salinity of the water a problem since they are farther away from the sea and the seawater has not seeped far enough inland to impact them. People living in those areas are more concerned with the insufficient water supply of the tap water generated by fresh water in the Kaeng Krachan Dam in Phetchaburi. They believe climate change causes insufficient rainfall, thus contributing to the low water supply in Kaeng Krachan Dam. We also found that using groundwater as a water source is becoming obsolete in residential areas by the shoreline since it is more convenient for people to get water from the tap. The Palace also uses tap water for their household needs, but for gardening, groundwater is the main source used.

## Deliverables & Recommendations

From this project, we created two deliverables which are a video and informative sign. This will help inform them about the effects of the man-made structures in the area. From the video, the local residents will understand how the existence of the jetties leads to salt contamination of fresh underground water. They will also be informed about how groynes, jetties, and breakwaters contribute shoreline erosion.

We recommend the Foundation of the Mrigadayavan Palace implements our informational video into the Palace museum area and sign on the Palace grounds for visitors and Palace staff members to view. We also suggested that the Palace organize an event that hosts both local residents and large tour groups at the Mrigadayavan Palace to make sure the local residents are aware of all of the effects the structures may have on the environment. By informing the public, the Foundation can gauge how the public may react to the change or removal of the structures. We believe the Palace should test water and soil for salinity in the Palace area regularly to monitor changes over time and ensure that salinity levels do not rise as well as research the overuse of underground water in nearby communities that may lower water table levels on the Palace grounds. Lastly, we suggest that the Palace propose to regulate the opening of jetties into the canals that were once freshwater sources.

## Conclusion

With our recommendations, the Foundation of Mrigadayavan Palace could provide useful information to different groups and audiences as well as provide a baseline to continue researching the effects of man-made structures, in order to make changes in the future.